DOCUMENT RESUME

ED 160 106 IR 006 393

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TITLE Assignment Procedures in the Air Force Procurement Management Information System.
INSTITUTION Air Force Human Resources Lab., Brooks AFB, Tex. Occupational and Manpower Research Div.
REPORT NO AFHRL-TR-78-30
PUB DATE Jul 78
NOTE 26p.

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Assignments; *Computer Oriented Programs; Job Analysis; *Job Placement; *Management Information Systems; *Personnel Management; *Personnel Policy; Policy Formation; Prediction; Vocational Aptitude

ABSTRACT

An overview is presented of the procedure for offering jobs in the Air Force Procurement Management Information System (PROMIS), an assignment system which makes possible the use of human resources research findings to improve individual personnel assignments. A general framework for viewing personnel assignment systems is presented; then job offering approach is described, involving the estimation of the value to the Air Force of each possible person-job assignment. The pay-off values generator is described including consideration of the interaction between the person's aptitude and the job aptitude requirement, the predicted technical school success, the aptitude area preference, the rate of job fill, and the percentage of jobs filled by minorities. The Allocation Index, used for ordering the opportunities list of jobs and based on a Decision Index, is also described. (Author/CMV)

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ASSIGNMENT PROCEDURES IN THE AIR FORCE PROCUREMENT MANAGEMENT INFORMATION SYSTEM

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July 1978
Interim Report for Period 1 January 1977 – 30 September 1977

Approved for public release; distribution unlimited.

AIR FORCE SYSTEMS COMMAND
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This interim report was submitted by Occupation and Manpower Research Division, under project 2077, with HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235.

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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: AFHRL-TR-78-30

2. GOVT ACCESSION NO.:

3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): ASSIGNMENT PROCEDURES IN THE AIR FORCE PROCUREMENT MANAGEMENT INFORMATION SYSTEM

5. TYPE OF REPORT & PERIOD COVERED: Interim, 1 January 1977 – 30 September 1977

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): Joe H. Ward, Jr. Manuel Pina, Donald L. Haney, William H. Hendrix

8. CONTRACT OR GRANT NUMBER(s):

9. PERFORMING ORGANIZATION NAME AND ADDRESS: Occupation and Manpower Research Division, Air Force Human Resources Laboratory, Brooks Air Force Base, Texas 78235

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 62703F, 20770407

11. CONTROLLING OFFICE NAME AND ADDRESS: HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235

12. REPORT DATE: July 1978

13. NUMBER OF PAGES: 24

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report):

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report):

18. SUPPLEMENTARY NOTES:

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

computer-based personnel assignment
job assignment
job requirements
personnel assignment
personnel selection
policy capturing
policy specifying
utility functions

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents an overview of the procedure for offering jobs in the Air Force Procurement Management Information System (PROMIS). The overview was presented at the 19th Annual Conference of the Military Testing Association, San Antonio, Texas, 19 October 1977.

A general framework for viewing personnel assignment systems is presented first. Then the job offering approach is described. The procedure involves the estimation of the value to the Air Force of each possible person-job assignment. These pay-off values are derived through Policy Specifying–a variation of Policy Capturing. The pay-off generator includes consideration of the interaction between the person's aptitude and the job aptitude requirement, the predicted technical school success, the aptitude area preference, the rate of job fill, and the

Item 20 Continued:

percentage of jobs filled by minorities. The Allocation Index used for ordering the opportunities list of jobs is based on a Decision Index which is described. Extension of the PROMIS assignment system can provide a vehicle through which human resources research findings can affect and improve individual personnel assignments.

PREFACE

During 1973, meetings were held between personnel of the Air Force Human Resources Laboratory (AFHRL) and Air Force Recruiting Service to discuss ways of enhancing the Procurement Management Information System (PROMIS). Feasibility studies and demonstrations of a prototype computer-based enlistment quota reservations system led to the development of the Air Force's Advanced Personnel Data System Procurement Management Information System (APDS-PROMIS). The computer-based system became operational 1 November 1976. Major inputs to the design of this system were provided by Mr. Tom Beatty, Mr. Bob Cantu, Capt Harry Haltman, Major Gordon Markham, Lt Col Jack Tillman and Capt Tom Van Sweringen.

This report presents an overview of the assignment system that was presented at the 19th Annual Conference of the Military Testing Association, San Antonio, Texas, 19 October 1977.

This research was completed under Work Unit 20770407, Post-Enlistment Person-Job-Match. Preliminary research was conducted under Work Unit 20770401, Development of an Advanced Pre-Enlistment Person-Job-Match System for Air Force Enlistees for ease in the All-Volunteer Environment.

The authors wish to thank Dr. Nancy Guinn, Personnel Research Division, AFHRL, for providing the Military Career Life Cycle illustration.

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ASSIGNMENT PROCEDURES IN THE AIR FORCE PROCUREMENT MANAGEMENT INFORMATION SYSTEM

I. INTRODUCTION

In July 1973, personnel from the Air Force Recruiting Service and Air Force Human Resources Laboratory (AFHRL) discussed strategies for examining the feasibility of a computer-based enlistment reservation system to enhance the existing Air Force Procurement Management Information System (PROMIS). A small computer-based job reservation system was developed using System 2000 data management system to demonstrate to recruiting service personnel the feasibility of on-line job reservations (Ward and Haltman, 1975). This demonstration, in September 1973, resulted in the development by Air Force Military Personnel Center, Recruiting Service and AFHRL of an operational job-reservation system (Pina & Stifle, in press). The system became operational 1 November 1976, with Air Force representatives at the sixty-six Armed Forces Examining and Entrance Stations (AFEES) inquiring through remote terminals to a Burroughs 6700 computer located at Randolph AFB, Texas.

This paper discusses: (1) designing personnel systems for acceptance and improvement, (2) a general framework for viewing personnel assignment systems, (3) the procedure for offering jobs in the PROMIS system.

II. DESIGNING PERSONNEL SYSTEMS FOR ACCEPTANCE, EVOLUTIONARY IMPROVEMENT, AND TECHNOLOGY TRANSFER

A personnel system may be viewed as a vehicle to aid in improving the effectiveness of an organization. To be useful, a personnel system should be <u>designed</u> for:

DESIGNING PERSONNEL SYSTEMS
FOR ACCEPTANCE AND IMPROVEMENT

- ACCEPTANCE BY MANAGERS AND MEMBERS OF THE ORGANIZATION
- EVOLUTIONARY (INCREMENTAL) ADJUSTMENTS LEADING TO CONTINUED IMPROVEMENT
- EASE OF INCORPORATING NEW HUMAN RESOURCES RESEARCH FINDINGS INTO THE OPERATIONAL PERSONNEL SYSTEM

Acceptance

If a personnel system is to have an opportunity to help an organization, it must continue to exist. In order to exist, it must be acceptable to managers and members of the organization. Designers of a personnel system must plan for initial and continued acceptance by members of the organization.

Evolutionary Improvement

Designers of a personnel system must allow for future changes--both expected and unexpected. The system should expect those future policy changes designed to improve personnel effectiveness. However, it is impossible to foresee the problems that can arise after operational implementation. The design features of the system that allow for change also help insure continued acceptance. The capability to change must be approached with caution, since too frequent or too much change might lead to non-acceptance and destruction of the personnel system.

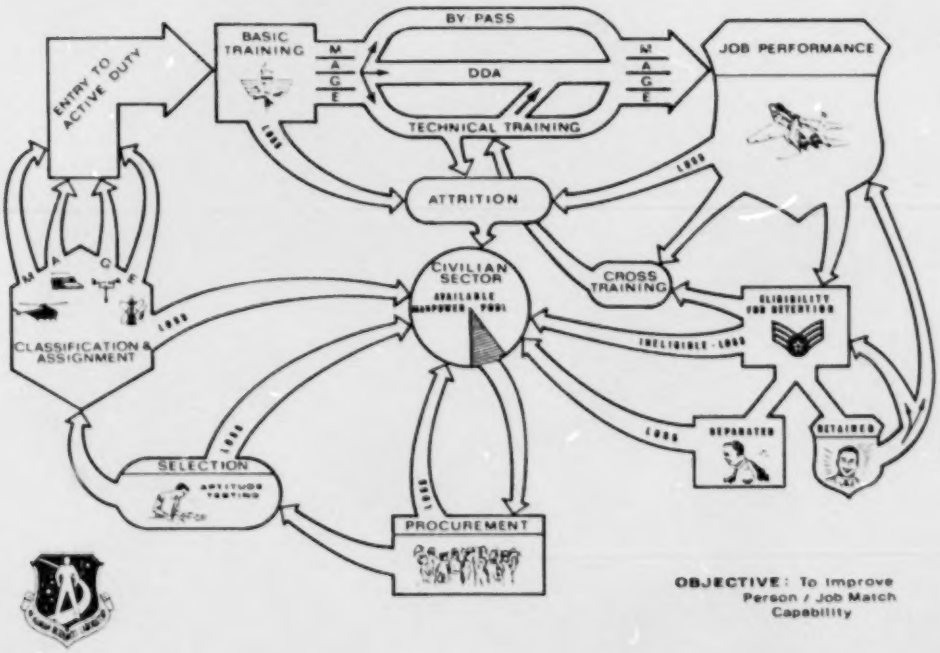
Incorporating New Research

In addition to allowance for expected management changes and unexpected problems, it is highly desirable to design a personnel system for acceptance of new human resources research findings. Some new technologies may require major modifications to the system. However, many future improvements can be incorporated easily into the operational system if it contains a technology transfer capability.

III. A VIEW OF PERSON-JOB ASSIGNMENTS

This section presents a view of person-job assignments that allows for user acceptance, evolutionary improvement, and transfer of new research findings. The concepts to be described emphasize information about jobs and people, pay-off or utility of particular person-job assignments, and the contribution of each particular assignment to overall system effectiveness. Before examining the details, it is helpful to look at the Military Career Life Cycle.

MILITARY CAREER LIFE CYCLE



This picture represents some of the personnel decision activities that take place during a military career. The objective is for persons to move through various job or training activities so that overall system effectiveness is maximized. The following ideas reflect some essential features of a personnel system designed for acceptance and improvement.

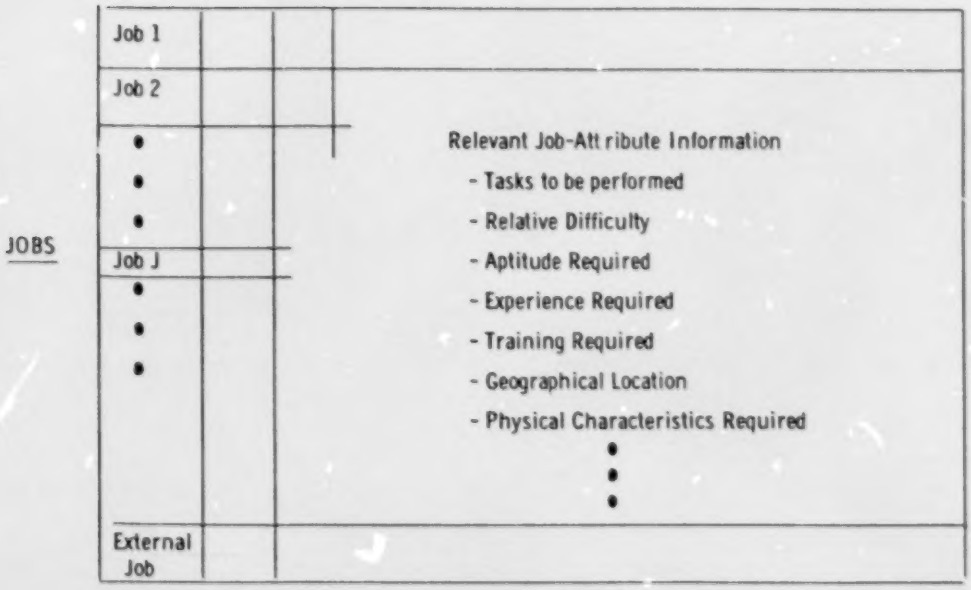
Activities to be Accomplished (Job and Training Requirements)

A necessary first step is the determination of the kinds of activities (jobs or training) that must be performed in the Air Force. This will be done from information about training requirements, job requirements, occupational surveys, and other sources. The attributes associated with jobs (or training positions) will be called job properties. Figure 1, the JOB PROPERTIES ARRAY, represents the relevant job-attribute information that is used in the personnel assignment system. The word JOB refers to any descriptive state of being that is occupied by or is potentially occupied by a person. The general term "jobs" can include

all Air Force jobs, plus activities that might be termed "training jobs." Another important "job" concept is the last one shown in Figure 1--called an External Job. This category provides for a job outside the particular sub-system of interest. The inclusion of an External Job allows for rejecting personnel by assignment to a "job" outside the system. In the Advanced Personnel Data System, Procurement Management Information System (APDS-PROMIS) each applicant occupies an External Job prior to assignment to an Air Force job.

Figure 1

JOB PROPERTIES ARRAY



Personnel Required to Accomplish the Activities

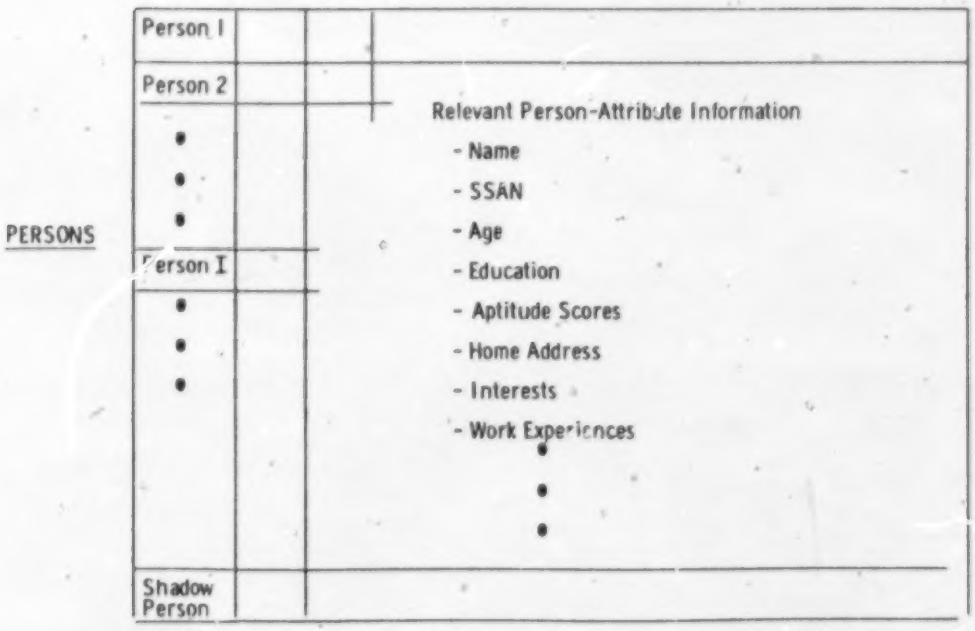
After the jobs have been determined it is necessary to identify the personnel who are available or potentially available to accomplish the activities required to operate the Air Force. The attributes associated with persons will be called person characteristics. Figure 2, PERSON CHARACTERISTICS ARRAY, represents the relevant person-attribute information that is used in the personnel assignment system. The word PERSON

refers to any individual who is a member of the Air Force or is a potential member of the Air Force.

The last person indicated in Figure 2 is called a Shadow Person. This Shadow Person provides for an imaginary person to be considered for assignment. The inclusion of this Shadow Person allows for consideration of Air Force jobs that are unfilled. The consequences of unfilled jobs (represented by assigning Shadow Persons) are important in the APDS-PROMIS System.

Figure 2

PERSON CHARACTERISTICS ARRAY



Pay-Offs Associated with Personnel Assignments

Next, it is necessary to determine some indication of effectiveness or pay-offs to the Air Force of assigning a particular person to a particular job. It is desired to find a way to combine different information related to pay-off or value into a single composite indicator. Information from management policy, from operations analysis studies, and human resources research must be combined to yield an indicator of

pay-off. The attempt to obtain such pay-off measures will be done through Policy Development procedures (Ward, 1977). Policy Development includes the combination of Policy Capturing and Policy Specifying. For Policy Capturing, a group of policy makers are presented performance-related information (technical school grades, job performance reports, or predictions of these variables, etc.) about a sample of persons and jobs. The judges (policy makers) will be asked to state the "pay-off" to the Air Force of this sample of persons associated with these particular jobs. Then, a computer will attempt to capture the policy of the judges by developing a mathematical model for predicting the judged values from the person and job information.

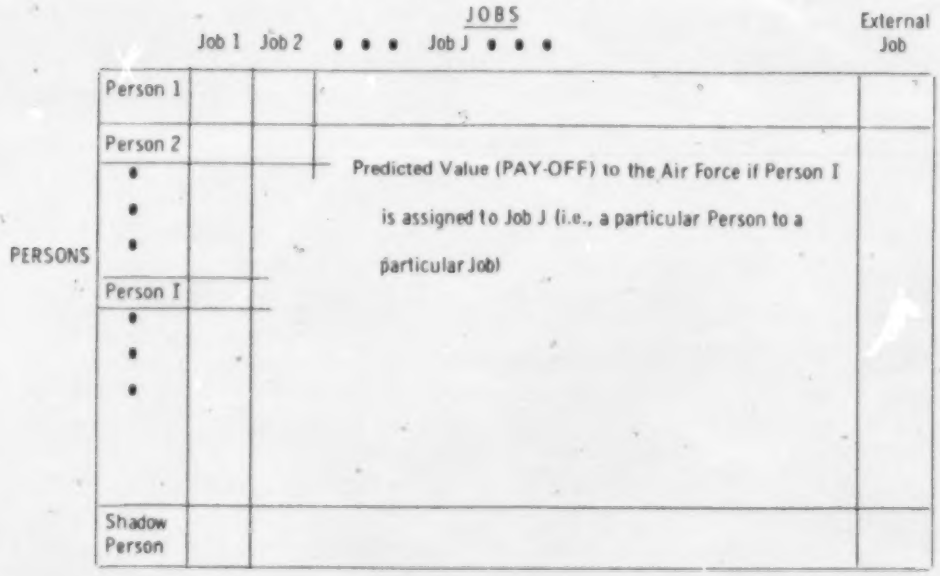
In Policy Specifying, managers express their "pay-off" to the Air Force of various person-job combinations through statements about general constraints that the mathematical model should have. When these constraints are imposed, a model evolves which will produce pay-off values consistent with the specified policy guidelines.

When appropriate, Policy Specifying and Policy Capturing can be combined to yield a mathematical model for estimating the value to the Air Force of any person for any Air Force job.

Figure 3, PREDICTED PAY-OFF ARRAY, represents the pay-off values estimated from the mathematical model using the person-job information. The pay-offs associated with the Shadow Person (last row) reflect the values to the Air Force (possibly negative values) of not filling various jobs. The pay-offs associated with the External Job (last column) reflect the values to the Air Force (possibly negative values) of not assigning each person to an Air Force job. In APDS-PROMIS, each applicant is already in an External Job and some applicants are not accepted into Air Force assignments.

Figure 3

PREDICTED PAY-OFF ARRAY



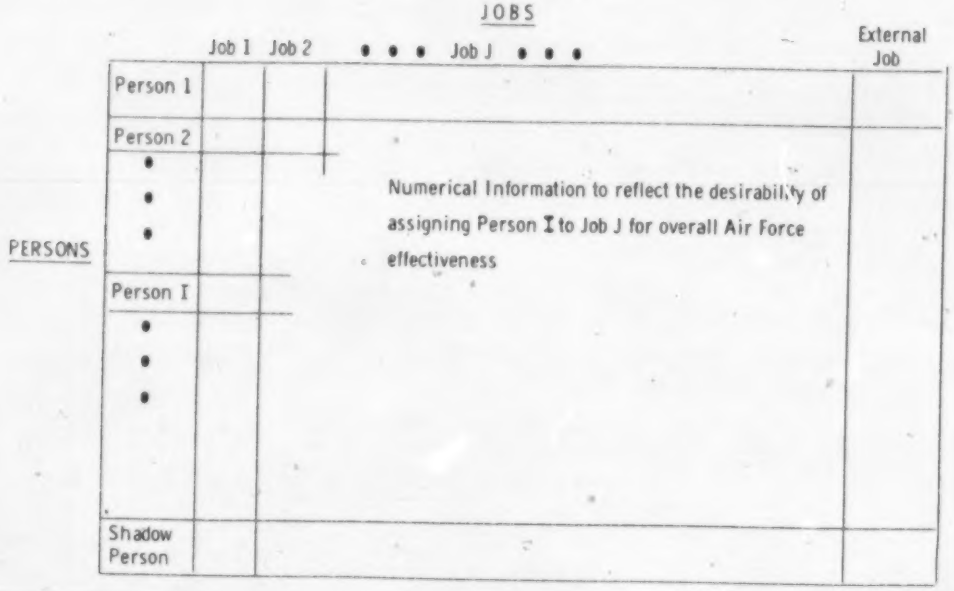
Allocation of Personnel for Overall Air Force Effectiveness

After the elements of the PREDICTED PAY-OFF ARRAY are available, it is necessary to allocate persons to jobs in a way that will tend to maximize overall Air Force effectiveness. The allocation process may not always assign a person to the job for which he has the highest pay-off to the Air Force since many persons must be considered for the job. The attempt is to make assignments that will tend to maximize overall Air Force effectiveness. Figure 4, ALLOCATION ARRAY, contains allocation indicators and represents the information that reflects the desirability for overall Air Force effectiveness of assigning particular persons to particular jobs. This information can reflect the results of an optimal allocation algorithm when appropriate (e.g., Langley's Primal Algorithm (Langley, Kennington, Shetty, 1974)). In this case, the elements of the ALLOCATION ARRAY will contain values of 1 where the assignments result in the maximum overall pay-off and 0 for the non-optimum assignments.

The ALLOCATION ARRAY may also reflect a wide range of numerical values (e.g., Ward's Decision Index (Ward, 1959)) that when used as a basis of assignment will tend toward maximum overall Air Force effectiveness. This approach is appropriate when a sequential-constrained-choice assignment is desired (such as in APDS-PROMIS), the problem is too large for optimum solution, or some of the data required for optimum solution is not available (Ward and Davis, 1963). Both optimum allocation algorithms (for batch assignments) and near-optimum procedures (for sequential-constrained-choice) should be available in a personnel system and used as appropriate.

Figure 4

ALLOCATION ARRAY



EXAMPLE OF PREDICTED PAY-OFF ARRAY AND ALLOCATION ARRAY, Figure 5 illustrates the difference between the PREDICTED PAY-OFF ARRAY and the ALLOCATION ARRAY. The elements of the allocation array reflect that assignment of person 1 to job 3 (allocation index = 14.0), person 2 to job 1 (allocation index = 14.0), and person 3 to job 2 (allocation index = 13.5) will maximize the sum of pay-off values (6 + 5 + 4 = 15). It is interesting to observe that an optimum allocation algorithm would produce an allocation array with values of 1 in the place of the index values 14.0 (Person 1, Job 3), 14.0 (Person 2, Job 1), 13.5 (Person 3, Job 2) to reflect the optimum assignments and 0 in the other 6 locations. However, the values that are now in the array provide for alternative assignments that maintain near optimality. This is operationally important in a system that provides for choice in either a sequential or batch assignment system. A person can be allowed to choose from jobs which have high allocation index values and thereby maintain high overall Air Force effectiveness. For example, if person number 1 were allowed to choose either job 2 or 3 - and he chose job 2 (second highest allocation index) then a pay-off sum of 13 would be possible. (Either 7 + 5 + 1 = 13 or 7 + 0 + 6 = 13).

Figure 5

EXAMPLE OF PREDICTED PAY-OFF ARRAY

AND ALLOCATION ARRAY

PREDICTED PAY-OFF ARRAY

JOBS

PERSONS	Job 1	Job 2	Job 3
Person 1	8	7	(6)
Person 2	(5)	1	0
Person 3	6	(4)	1

ALLOCATION ARRAY

JOBS

PERSONS	Job 1	Job 2	Job 3
Person 1	11.0	13.0	(14.0)
Person 2	(14.0)	11.5	12.5
Person 3	13.0	(13.5)	11.5

The higher numbers in the Allocation Array reflect the desirability of assignments for overall effectiveness of the Air Force

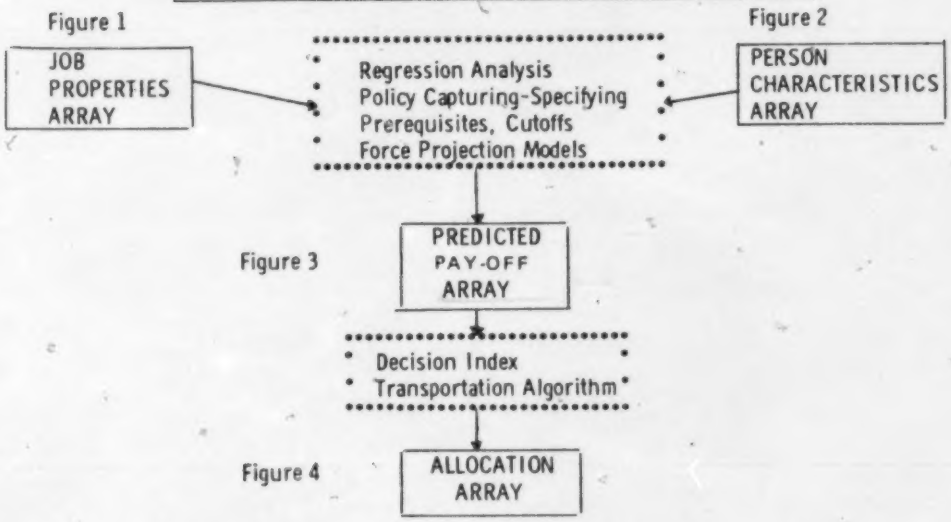
[Overall Effectiveness = 6 + 5 + 4 = 15]
When Highest
Allocation Indexes
Are Used

Summary of the Personnel Assignment System

Figure 6 summarizes the basic features of the personnel assignment system. Information about jobs (Figure 1) and people (Figure 2) is mixed to generate a pay-off (or value) of each potential person-job assignment (Figure 3). From the pay-off array an allocation array (Figure 4) is produced to indicate the appropriateness of each potential assignment for overall Air Force effectiveness.

Figure 6

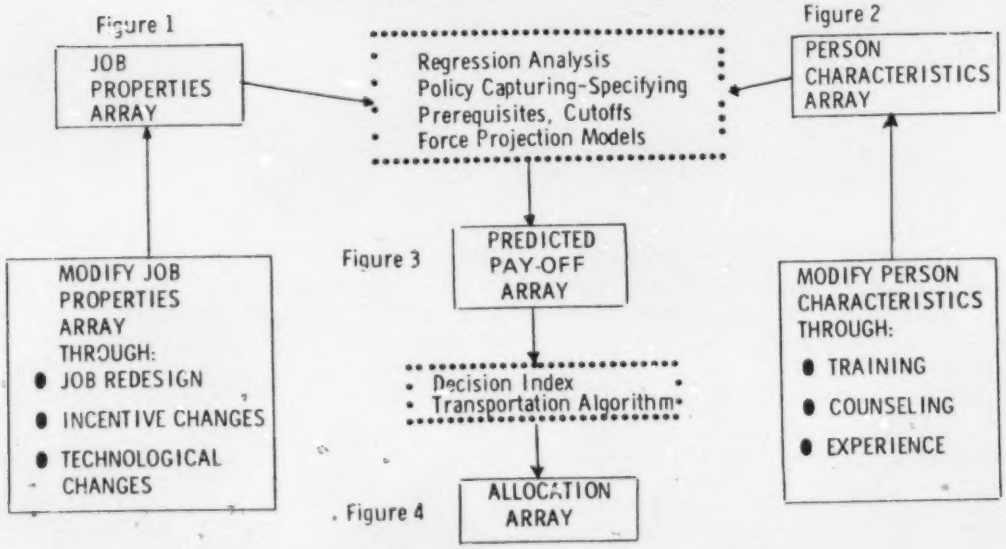
SUMMARY OF THE PERSONNEL ASSIGNMENT SYSTEM



While Figure 6 summarizes the personnel assignment system which considers personnel and jobs as they exist - Figure 7 represents the modification of job properties and modification of person characteristics so that the pay-off array can be improved. Continued personnel training, occupational re-design and organizational improvement can bring about desired changes in personnel and jobs.

Figure 7

A VIEW OF PERSONNEL ASSIGNMENTS
INCLUDING TRAINING AND JOB MODIFICATION



The generalized, modifiable personnel assignment system described above combined with changes in jobs and people characteristics should result in improved Air Force effectiveness. The following section describes the application of these ideas to APDS-PROMIS.

IV. ADVANCED PERSONNEL DATA SYSTEM PROCUREMENT MANAGEMENT INFORMATION SYSTEM (APDS-PROMIS)

The Air Force Recruiting Service lists the characteristics of APDS-PROMIS shown below.

WHAT IS APDS-PROMIS?

- Real-time computer system to replace telephone link
- Job counseling transferred to AFEES processing team
- Computerized preenlistment job classification (P/J match)
- Recruiting objectives for 210 days
- Improved requirement accounting
- Reduced manual reporting
- More professional recruiting image

The following special features were considered in the design of the system:

SPECIAL FEATURES OF

PERSON-JOB MATCH FOR PROMIS ENHANCEMENT

- Sequential consideration of persons to be assigned
- Future accessions are unknown
- List of opportunities must be provided
- Opportunities must be immediately available

SPECIAL FEATURES

FOR ACCEPTANCE AND MAINTENANCE

- Pay-off functions easy to define and modify
- Effects of modifications are easily visible on opportunities list
- Provide capability through which human resources research findings can affect and improve individual personnel assignments

Opportunity

The major component of PROMIS is the OPPORTUNITY command. The following events provide the ordered list of jobs from which an applicant may choose:

OPPORTUNITY

Person/Job Match

- Input applicant aptitude, physical & preference data
- Test qualification for jobs
- Test availability of jobs
- Compute 'worth' (appropriateness) value for each job
- Maximize total worth to Air Force and individual
- Provide list of most appropriate jobs
  - Guaranteed Training Enlistment Program (GTEP)
  - Open enlistment
- Offer option to reserve job from list

Predicted Pay-Off Values. As indicated above an essential step is the creation of a pay-off array. There are five components contributing to the pay-off values.

CREATING PREDICTED PAY-OFF
OF A PERSON-JOB COMBINATION
USING
POLICY SPECIFYING

- Person-Aptitude and Job Difficulty
  (The A-D Component)
- Technical training success
- Aptitude area preferences
- Rate of job fill
- Minority job fill

Aptitude Potential and Job Difficulty. Research findings and experienced personnel people have indicated that interacting a person's aptitude with the job's aptitude requirements so that the most talented people are assigned to the most demanding jobs will reduce training costs, increase job satisfaction and productivity, and improve personnel retainability. This concept has been implemented through the A-D (Aptitude-Difficulty) component.

APTITUDE POTENTIAL AND JOB DIFFICULTY

$Y = f(A, D)$

where

A = Aptitude for particular job

D = Relative difficulty of particular job

A three-dimensional view of this component is shown in Figure 8.

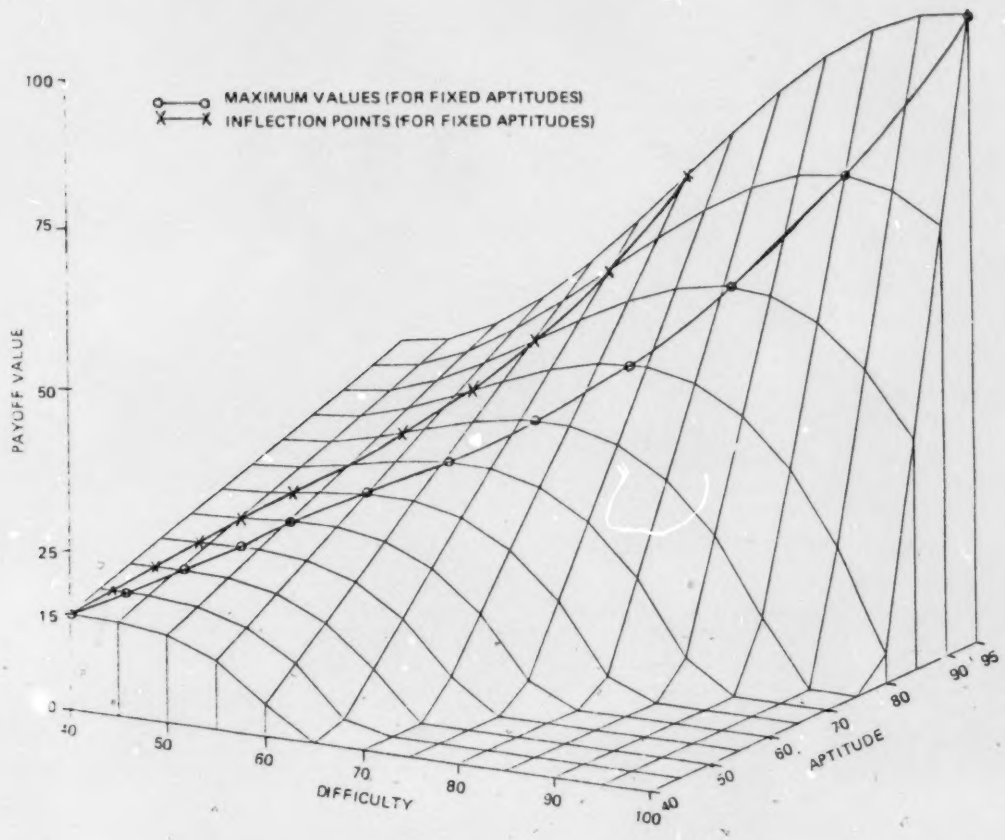


Figure 8. Pay-Off Function of Aptitude and Difficulty.

This figure indicates that for a low difficulty job--for example, D = 40--there is a slight increase in pay-off as aptitude increases; however, for a higher difficulty job--for example D = 60--the increase in pay-off is more rapid. Also, notice that for a low aptitude person --for example Aptitude = 40--the highest pay-off is on a low difficulty job, with the pay-off decreasing rapidly as difficulty increases. And for higher aptitude persons the best pay-off is on higher difficulty jobs. A person will have maximum pay-off when his aptitude closely matches the job requirements. And higher aptitudes matched to more difficult jobs are more valuable than lower aptitudes matched to less demanding jobs.

At the present time, only that part of the function to the left (or higher side) of the ridge is getting any use because existing ineligibility rules do not allow applicants who have aptitudes below a certain cut-off to be considered for a job--i.e., the worth below the cut-off is

negative infinity! However, if policy makers allow applicants to become eligible for jobs slightly below existing cut-off scores the pay-off function is available for use. Slight lowering of cut-off rules would allow greater flexibility for making personnel assignments.

Technical Training Success. The second component is technical training success. This function involves predicted technical school success from aptitude tests, high school courses taken, the particular technical school, and high school graduation status.

TECHNICAL TRAINING SUCCESS

$$Y = f(\text{ASVAB, AFQT, HS courses, Tech Schools})$$

Aptitude Area Preference. Each applicant expresses a relative preference weighting for the four areas -- Mechanical, Administrative, General, and Electronics. These preferences are considered in the pay-off function.

APTITUDE AREA PREFERENCES

$$Y = f(\text{M, A, G, E preferences})$$

where

M = Mechanical AI

A = Administrative AI

G = General AI

E = Electronics AI

This component may be replaced in the future by the Vocational Interest Career Examination (VOICE).

Job Fill Rate. This dynamic feedback component is of extreme importance to recruiting service. It reflects interaction between the percentage of jobs filled, amount of time since job was released, and a priority associated with each job. As each job is reserved, and as time changes, this component is modified to change emphasis on jobs that are ahead or behind a desired rate of fill.

JOB FILL RATE

$$Y = f(P_j, T, K)$$

where

P_j = Percentage of Jobs Filled

T = Amount of time since job release

K = Job fill priority

This job fill rate component is in the process of being modified to reflect the actual number of unfilled jobs interacting with the other three job properties -- percentage fill, time, and priority.

Minority Job Fill

This dynamic component is continuously adjusted to help achieve a specified minority balance across jobs.

MINORITY JOB FILL

$Y = f(P_m, G)$

where

P_m = Percentage of jobs filled by minorities

G = Desired minority job fill goal

Maximizing Overall Air Force Effectiveness. PROMIS requires presentation of an ordered list of jobs from which applicants may choose. An Allocation Index is computed that reflects the desirability for overall Air Force effectiveness of assigning the applicant to each job on the list. An Allocation Index called the Optimality Indicator is used as the basis of ordering. This index is based on the Decision Index (Ward, (1959)) described above.

ASSIGNMENT OF PERSONNEL
TO MAXIMIZE OVERALL AIR FORCE EFFECTIVENESS

Decision index used as the allocation index
for ordering the opportunities list

V. PLANNED IMPROVEMENTS TO PROMIS

The evolutionary capability of the system allows for incorporating modifications as required. Planned improvements are shown below.

PLANNED IMPROVEMENTS

- Modify fill-rate component to reflect actual number of jobs unfilled
- Combine the aptitude-difficulty component interactively with the fill-rate component to reflect policy in which the importance of fill-rate is different for different levels of the aptitude-difficulty component
- Combine attrition prediction information with training costs into the pay-off function to direct good risks to more expensive training and poor risks to less expensive training
- Introduce results from the Vocational Interest Career Examination (VOICE) into the pay-off function to improve job satisfaction and personnel retainability
- Consider interaction of the aptitude-difficulty component with the VOICE (interest) component

VI. APPLICABILITY TO OTHER PERSONNEL SYSTEMS

The concepts above can be applied to any personnel system that would like to match person characteristics with job properties and produce either an ordered list of job opportunities from which an applicant may choose (as in APDS-PROMIS) or an ordered list of applicants from which a job manager may choose (as when a job must be filled). The airmen post-enlistment assignment system, now being developed, should be applicable to a wide variety of personnel sub-systems--airmen, officers, and civilians.

APPLICABILITY TO OTHER PERSONNEL SYSTEMS

- Air Force enlisted re-assignments
- Officers assignments
- AF civilians
- Others

VII. SUMMARY OBSERVATIONS

A mechanism is evolving through which human resources research findings can directly affect and improve individual personnel assignments. System flexibility provides for modification and introduction of new components to insure continued acceptance and improvement. The approach has general applicability to personnel systems that can identify information about persons and jobs and specify a pay-off generating policy.

Implementation of this approach has led to identification of areas of human resources research that will contribute significantly to improved systems performance.

RESEARCH AREAS OF POTENTIAL VALUE

- SEARCH FOR PERSON CHARACTERISTICS AND JOB PROPERTIES THAT INTERACT IN PREDICTION OF PAY-OFF VALUES
- DEVELOP NEW METHODS FOR SPECIFYING THE PAY- OFF VALUES ASSOCIATED WITH PERSON-JOB ASSIGNMENTS
- STUDY THE USE OF ALLOCATION INDEXES NOT ONLY AS AN ORDERING VALUE FOR OPPORTUNITY LISTS, BUT AS A SUPPLEMENT TO APTITUDE INDEXES NOW IN USE

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